

What is claimed is:

- 1           1.       A method of determining if a link is alive, comprising:  
2                   establishing a secure link between a first node and a second node  
3       according to a security protocol;  
4                   sending at least one ping message targeting the second node over the  
5       secure link, the at least one ping message defined outside the security protocol; and  
6                   monitoring for at least one ping reply to determine if the secure link is  
7       alive.
- 1           2.       The method of claim 1, wherein establishing the secure link comprises  
2       establishing a virtual private network session.
- 1           3.       The method of claim 1, wherein establishing the secure link comprises  
2       establishing a link protected by an Internet Protocol Security protocol.
- 1           4.       The method of claim 3, wherein sending the at least one ping message  
2       comprises sending at least one Internet Control Message Protocol message.
- 1           5.       The method of claim 1, wherein sending the at least one ping message  
2       comprises sending at least one Internet Control Message Protocol message.
- 1           6.       The method of claim 1, wherein establishing the secure link comprises  
2       establishing the secure link between first and second nodes each comprising a security  
3       gateway.
- 1           7.       The method of claim 6, further comprising sending at least one ping  
2       message targeting another node behind the second node.
- 1           8.       The method of claim 7, further comprising monitoring for at least one ping  
2       reply form the other node.

1           9.     The method of claim 1, further comprising tearing down the secure link if  
2     the secure link is determined not to be alive.

1           10.    The method of claim 9, wherein tearing down the secure link comprises  
2     tearing down a security association according to an Internet Protocol Security protocol.

1           11.    A method of communicating with a remote node, comprising:  
2                establishing a secure link between a first security gateway and a second  
3     security gateway, the remote node in communication with the second security gateway;  
4                sending at least one ping message to the remote node over the secure link  
5     and through the second security gateway; and  
6                monitoring for at least one ping reply from the remote node to determine if  
7     the secure link is alive.

1           12.    The method of claim 11, wherein establishing the secure link comprises  
2     establishing a secure link protected according to an Internet Protocol Security protocol.

1           13.    The method of claim 11, wherein establishing the secure link comprises  
2     establishing a virtual private network session.

1           14.    The method of claim 11, wherein establishing the secure link comprises  
2     establishing a secure link protected according to a security protocol.

1           15.    The method of claim 14, wherein sending the at least one ping message  
2     comprises sending at least one ping message defined outside the security protocol.

1           16.    The method of claim 15, wherein sending the at least one ping message  
2     comprises sending an Internet Control Message Protocol message.

1           17.    The method of claim 16, wherein establishing the secure link comprises  
2     establishing a secure link protected according to an Internet Protocol Security protocol.

1           18.    A system for communicating between a network element and a remote  
2 node, comprising:  
3                a security module adapted to establish a secure link with the remote node,  
4 the secure link having a security mechanism according to a security protocol; and  
5                a keep-alive module adapted to send at least one ping message over the  
6 secure link to the remote node, the at least one ping message defined outside the security  
7 protocol.

1           19.    The system of claim 18, wherein the security protocol comprises an  
2 Internet Protocol Security protocol.

1           20.    The system of claim 18, wherein the at least one ping message comprises  
2 an Internet Control Message Protocol message.

1           21.    The system of claim 18, further comprising:  
2                an interface to a packet-based network, the secure link established over the  
3 packet-based network; and  
4                a layer to control communications over the packet-based network.

1           22.    The system of claim 21, wherein the layer comprises an Internet Protocol  
2 layer.

1           23.    The system of claim 18, wherein the keep-alive module is adapted to  
2 further monitor for at least one ping reply responsive to the at least one ping message to  
3 determine if the secure link is alive.

1           24.    The system of claim 23, wherein the security module is adapted to tear  
2 down a security association of the secure link if the secure link is not alive.

1           25.    The system of claim 24, wherein the security association comprises an  
2 Internet Protocol Security protocol security association.

1           26.    The system of claim 18, wherein the keep-alive module is adapted to  
2 further monitor for at least one ping reply responsive to the at least one ping message to  
3 determine if the secure link is alive, the system further comprising a module adapted to  
4 establish a link over a secondary communication network if the secure link is not alive.

1           27.    An article comprising at least one storage medium containing instructions  
2 for controlling communications, the instructions when executed causing a controller to:  
3                establish a secure link between a first node and a second node according to  
4 a security protocol;  
5                send at least one ping message targeting the second node over the secure  
6 link, the at least one ping message defined outside the security protocol; and  
7                monitor for at least one ping reply to determine if the secure link is alive.

1           28.    The article of claim 27, wherein the instructions when executed cause the  
2 controller to further establish an Internet Protocol security association for the secure link.

1           29.    The article of claim 28, wherein the instructions when executed cause the  
2 controller to tear down the security association if the controller does not receive the at  
3 least one ping reply.

1           30.    The article of claim 27, wherein the controller is part of the first node.

1           31.    A data signal embodied in a carrier wave and containing instructions for  
2 controlling communications, the instructions when executed causing a system to:  
3                establish a secure link between a first gateway and a second gateway;  
4                send at least one ping message to a remote node over the secure link and  
5 through the second security gateway; and  
6                monitor for at least one ping reply from the remote node to determine if  
7 the secure link is alive.